VII. *Some Rest-Attitudes of Butterflies.* By G. B. Longstaff, M.D., F.E.S.

[Read March 7th, 1906.]

About a year ago I called the attention of Fellows to the attitudes assumed by certain Indian butterflies when at rest, noting especially the following points: (1) Heliotropism, or the turning of the body-axis so that the head is away from the sun; (2) the habit of certain Lycænids of resting head downwards; and (3) a sideways attitude, a tilting or "list" of certain Satyrids to the right or left.*

Heliotropism.

Professor G. H. Parker appears to have been the first to describe what he terms the "negative heliotropism" of *Vanessa antiopa*, L., in the United States. He records his numerous observations in great detail, and states that some species of *Grapta* have the same habit. The object of the creature thus turning its tail to the sun is, he believes, to display its colouring to the greatest advantage.†

Mr. E. E. Green, describing the cryptic habits of *Melanitis ismene*, Cr., in Ceylon, says: "I have watched the fly, immediately after pitching, alter its position so that its axis is directed towards the sun, thus casting no shadow." ‡

Quite independently and perhaps at about the same time as Mr. Green (October 1903) I saw near Simla, *Pararge shakra*, Koll., settle three times with its back to the sun, and noted that its shadow was thereby reduced to a mere line. When a butterfly with cryptically coloured under-side rests upon a flat surface in bright sunshine its shadow is often more conspicuous than the insect itself, so that economy of shadow may be a valuable means of protection.

[The author showed specimens of South African Nymphalids set in the usual manner, but close to the paper, and also with the wings closed as at rest, placed upon

* Trans. Ent. Soc. Lond., 1905, pp. 85, 126, 135, 136.

† *Mark Anniversary volume*, Cambridge University, Mass., U.S.A., 1903, pp. 453–469.

‡ *Spolia Zeylanica*, vol. ii, pt. vi, Aug. 1904, p. 76.

backgrounds of sand-paper of various colours to imitate natural backgrounds of sand or rock.]

Admitting the fact of Heliotropism a third possible explanation suggests itself. This special attitude exposes not only wings, but the insect's body, most completely to the sun's rays, and we may fairly suppose that such an essentially sun-loving creature as a butterfly finds them agreeable. To this explanation Dr. Dixey advances an at least partial objection, viz.: that when the wings are closed up both wings and body are *least* exposed to the sun's rays.

As the result of numerous observations made in Algeria in February and March 1905, I satisfied myself that:

> Except early in the day, or when the sun is dull, or when feeding on flowers, *Pararge meone*, Cr., settles with the axis of the body turned so that the tail points more or less accurately to the sun, therefore when the wings are raised, in the attitude of repose . . . the shadow is reduced to insignificant dimensions.*

After somewhat intimate acquaintance with *P. meone*, Cr., in Algeria, it was pleasant, in May 1905, to study its northern form *P. ægeria*, L., which is common in and about my garden at Mortehoe, North Devon, and this was the more pleasant because our butterfly is undeniably much more beautiful than its southern sister.

I have notes on ten specimens observed, and it may be instructive to give them in detail.

> May 3. Observed two *P. ægeria*; one settled several times with tail to the sun, the other was less particular.
>
> May 9. Saw *ægeria* settled with wings open and tail directed towards the sun.
>
> May 15. Saw one specimen of *ægeria* settle twice with fairly accurate orientation; another specimen settled first accurately oriented; then it settled again with the body nearly at right angles to, but with the head somewhat towards, the sun; thirdly it settled again at right angles, but with its head turned to the opposite side.
>
> May 19. Watched three specimens of *ægeria* and saw each of them orient itself accurately twice. The same day I saw another specimen orient itself four times.

* Proceedings Ent. Soc. Lond., 1905, p. xxix.

My last observation was made on an *ægeria* within a few yards of my study window; this I disturbed many times with a view to noting its behaviour; out of seventeen occasions it oriented itself correctly but five times, it faced the sun once, but placed itself at right angles to its rays no less than eleven times!

The unusual behaviour of this butterfly gives strong proof that individual flies may differ much in behaviour, and as I should be disposed to describe it, in moral character. What entomologist who has sugared regularly in the same place has not observed among common *Noctuæ* some individuals bolder and greedier than others?

I often saw *meone* settle on sandy roads, rocks, or walls, but the *ægeria* here referred to were for the most part settled on leaves, and the question of protection by economy of shadow could scarcely arise in their case.

The next subject of observation was *Pararge megæra*, L., which was especially interesting to me as nearly allied to *P. shakra*, Koll., the common Himalayan butterfly in which I first noted heliotropism in October 1903.* The spring brood was not so numerous as the summer brood usually is, and only ten specimens were noted settled. Of these the first, a female, was watched on a Devonshire "dry ditch," settling for the most part on the rough slates of which it was built, that is to say, on surfaces not always well adapted for precise orientation. It was however observed to settle several times with its tail to the sun, and on one of these occasions it raised its wings over its back so that its shadow was scarcely visible, but two or three times it settled at right angles to the sun. Six other specimens were observed with their wings open, settled for the most part on flat ground, and all correctly oriented (one observed twice). Another specimen was first seen settled on the flowers of *Potentilla tormentilla*, Sibth., at right angles to the sun, but afterwards on *Scilla nutans*, Sm., correctly oriented. Yet two other *megæra* were seen settled, one on the road, the other on a flat stone, both with their wings closed up, correctly oriented, so as to throw practically no shadow.

During May 1905 hybernated specimens of *Vanessa io*, L., were unusually common at Mortehoe, and the attitudes of at least fifteen different individuals were noted on seven different days. Of these, eleven, or three-fourths, oriented

* Trans. Ent. Soc. Lond., 1905, p. 67.

themselves correctly so as to turn their tails to the sun. Of the minority, the one-fourth that settled otherwise than with tail to the sun, two were settled on the flowers of the wild hyacinth or "blue-bell" (*Scilla nutans*, Sm.), and of these one was facing the sun. A third specimen, settled on flowers of lilac (*Syringa persica*), appeared to be quite indifferent to the sun's direction. The fourth was at first settled facing the sun, but it very soon moved, settled again, and at once adjusted its position so as to be perfectly oriented with tail to the sun. I subsequently watched the same butterfly settle three times, the first time with tail turned to the sun correctly, but the second and third times it alighted on "blue-bells" and did not orient itself.

Vanessa urticæ, L., was far less common and only two specimens offered themselves for observation, of which the first was twice seen to adjust itself to correct orientation, but the second, on the same lilac bush with the *V. io* mentioned above, appeared like it to be indifferent to the sun's direction.

From the preceding observations it may fairly be inferred that *Vanessa io* (and probably also *V. urticæ*) when settled in full sunshine, except sometimes when feeding on flowers, habitually places itself so that its tail is directed towards the sun. As however the butterflies were not seen to close their wings over their backs nothing can be said as to the shadow question.

The next species that came under my notice was *Melitæa aurinia*, Rott., which was very abundant in a restricted North Devon locality. All the specimens observed were settled on flowers or low plants. In the great majority of cases the wings were fully expanded, though a few had the fore-wings drawn back so as to form an approximation to the "Deltoid" shape. In order to secure perfect fairness my method was to record the position of *every* specimen seen so long as the sun was shining brightly. Three series of observations were thus made, with the following results :—

	First series.	Second series.	Third series.	Total
Tail to sun.	13	29	69	111
Side to sun.	2	6	9	17
Head to sun.	1	2	0	3

Adjustments after settling were often noticed, occasionally repeated adjustments. When there was a wind

they settled at first with their heads to it, one butterfly succeeding in orienting itself only after much struggle. When the sun was not shining they were often noted settled at right angles to its direction.

In the case of *M. aurinia*, under the circumstances in which the butterfly occurred, it is difficult to see that the amount of shadow thrown could have been of any moment, though doubtless its colours would show up more if the under-sides of the hind-wings when at rest had the sun shining directly *on* them rather than tangentially.

The recent visit of the British Association to South Africa gave me more extended opportunities; it gave me moreover the advantage of Dr. F. A. Dixey's co-operation, which was the more valuable by reason of his great patience in observing and careful accuracy in recording results.

Eurytela hiarbas, Dru., is a Nymphalid butterfly, with a very Satyrine aspect and habits not unlike those of *P. ægeria*. It is common in woods round East London and Durban, affecting partial shade. At East London I saw it in a small wood within 100 yards of high-water mark. It does not seem to be attracted by flowers, but moves about bushes with a slow gliding flight; it may settle on leaves, or on the ground, the wings being commonly three-fourths expanded, though sometimes more fully. When thus settled the wings are often slowly shut in part and again opened, though I never saw them quite shut. On at least three several days they were noted to have their tails turned to the sun, but the orientation was imperfect, often 15°–30° out, and occasionally they settled with the body axis at right angles to the sun.

Precis elelia, Cr., is a Nymphalid butterfly that is common and widely distributed in South Africa. The dark upper surface of the wing is rendered very conspicuous by white spots near the tip of the fore-wing and a large blue spot on the hind-wing, but the under-side is marbled with shades of light grey and is very quiet and unobtrusive. As regards its habits I cannot do better than quote Dr. Dixey's very graphic account of its behaviour as observed in "the Old Cemetery," at Sydenham, near Durban, in the middle of August:—

> Common at one spot in the cemetery. It has a habit of flying a little way, sometimes in pursuit of another butterfly, making a round and returning to

the same, or nearly the same place. It settles on the ground, or on a low plant, nearly always turning its back to the sun, and often closing its wings over its back. I saw one settle at right angles to the sun, casting a broad shadow; but as there happened to be several objects close by casting similar shadows, it was not very conspicuous. Presently the same individual flew up and settled down again, this time on a bare piece of earth and with its back to the sun in the usual way.

Another note, also relating to Sydenham, is :—

P. clelia seen to settle, and then rapidly turn its back to the sun; it did not close its wings. *P. clelia* seen here seems *always* to turn its back to the sun.

To Dr. Dixey's description I would add that the wings are usually about three-fourths expanded, nearly as with *Vanessa atalanta*, L., at home. One specimen was observed to settle with tail to the sun five consecutive times. It was only occasionally that I saw them close their wings over their backs, when the shadow was reduced to a minimum, but I did observe this several times, both in the neighbourhood of Durban and at the Victoria Falls. As a rule *P. clelia* seemed to pitch correctly, but now and then it was seen to adjust itself.

Precis crebrene, Trim., is another common and widely-distributed South African butterfly. Though very differently coloured from *P. clelia*, it is nearly, though not quite, as conspicuous when the upper-side is displayed, but the almost uniformly clay-coloured under-side is scarcely distinguishable against certain back-grounds, such as sand, clay, or rock of a grey or yellow tint. It is fond of frequenting dry "spruits," or watercourses, settling on the rocks or boulders, but in the Zambesi country Dr. Dixey often saw it settle in trees. It was repeatedly observed to orient itself fairly accurately, but did not appear to close its wings as often as *P. clelia*. A note made by me at Ladysmith, August 26th, says :—

Oriented within about 10°–15°; settled often upon cliffs of yellow sand or mud on which it was moderately conspicuous. One specimen was repeatedly observed to close its wings, its shadow was then near the minimum and the insect inconspicuous.

Precis natalica, Feld., a somewhat dingy species, though generally distributed, was much less common than the two preceding. It is somewhat of a shade-lover and usually settled on the ground or on a leaf, its wings more spread than *clelia* or *crebrene*. Except when settled in the shade its tail was directed towards the sun. One was seen to close and open its wings, another was watched for some time and observed over and over again to orient itself correctly, and twice to close its wings so as to leave practically no shadow.

Precis elgiva, Hew., is not uncommon in woods near Durban, it was noted as sitting with wings fully expanded and tail to the sun.

Precis sesamus, Trim., is a large, dark, handsome butterfly which reminds one of *Vanessa io*, L. It is fond of hiding itself in ditches and under dark banks, often several together; this is not always done with a view to seek shelter from the wind, though on some occasions that seemed to be the object. It pitches with the wings fully expanded and close to the ground, just as *P. natalica* ; in this position it is less conspicuous than might be supposed, especially when it settles on dark clay, or peaty soil, as it appeared to be fond of doing. Both Dr. Dixey and I saw it orient itself like its congeners, sometimes with adjustment. On one occasion only did I see it close its wings over its back, casting, as a result, a minimum shadow.

Another *Precis*, nearly the colour of the red soil, but more orange in tint, was observed to orient with tail to the sun. This I saw several times but missed; it was on August 18th, on somewhat open ground at the edge of a large banana garden above the Congella woods, Durban. I thought at the time that this was *P. octavia*, Cram., the wet-season form of *P. sesamus*, but it is just possible that it may have been *P. cloantha*, Cram., which I took on the other side of Durban. With the possible exception of this doubtful *Precis* all my remarks about South African butterflies apply to dry-season forms.

Hamanumida dædalus, Fab., is a common African Nymphalid that we only met with on the banks of the Zambesi. We both noted that it usually flies near the ground, on which it settles with the wings closely adpressed to the surface. It occasionally flaps its wings, but as long as they are still it is very inconspicuous, its grey colour approximating closely to that of the sand, the whitish spots

aiding its concealment by breaking up the surface. One was observed to walk about on mud regardless of the sun's direction, but it finally settled down with tail to the sun and wings spread out in the usual way.

[*Abisara* (*Zemeros*) *flegyas*, Cr., a common oriental Erycinid, has a strikingly similar pattern to the last-named Nymphalid, but I do not know what its favourite resting-places are.]

Pyrameis cardui, L. I summed up my observations on this butterfly in Algeria in the following words:—

> I can confidently say that it generally settles with its tail to the sun, though it does not do this with the regularity of *Pararge meone*. I saw two specimens turn their faces to the sun, and saw a third settle twice with its body at right angles, though the third time it settled normally.*

At Durban, on August 21st, I watched this cosmopolitan butterfly orient, but full weight must be given to the following very definite observation of Dr. Dixey's when watching lizards:—

> Ladysmith (North East Defences), Aug. 27th, watched several *P. cardui*, which settled frequently. They would settle at any angle with regard to the sun, but perhaps rather more often with back to it. They fanned their wings, and often shut them up tight (keeping them so for some time) in *any* position with regard to the sun.

This was late in the afternoon, but I do not gather from Dr. Dixey (nor from personal recollection) that the sunlight was feeble, or that there was a strong wind, or that the butterflies were feeding or drinking—all disturbing causes. There can I think be no doubt that the habit of heliotropism is not as fixed in "The Painted Lady" as in many Nymphalids.

Among our notes on heliotropism there are but three references to Pierines. The first is interesting as tending to negative the suggestion that the purpose of heliotropism is to minimize the butterfly's shadow and so aid in its concealment. Dr. Dixey writes:—

> Durban (The Bluff), August 16th. *Teracolus ione*, Godt. (*speciosus*, Wallengr. = *jobina*, Butl.) ♂. When first seen it was settled in the sunshine with wings expanded; then it flew a short distance

* Proc. Ent. Soc. Lond., 1905, p. xxix.

> and settled on a reddish sandy path. Cloud came over the sun, and the butterfly closed up its wings, so that only the hind-wing and tip of the fore-wing were visible.

In explanation of this note Dr. Dixey emphasizes the fact that in the dry-season form of *ione* (= *speciosus*, Wallengr.) the under-side of the hind-wing and the tip of the fore-wing are reddish, hence the tightly-closed attitude is cryptic on red soil. He adds that doubtless when the butterfly contemplates a long stay (as at night, or when the sun goes behind cloud) the closed-up attitude is adopted to take advantage of its cryptic colouring, and not to minimize its shadow.

The other observations were made on *Belenois severina*, Cram., a white butterfly that we found very abundant at Durban.

Dr. Dixey says:—

> *B. severina*, ♂ and ♀; when clouds come over the sun, this species generally settles on a grass stem, and, closing its wings tightly, becomes part of the picture. It certainly generally turns its back to the sun when it settles in sunshine, and then does not often close up its wings.

My note is as follows:—

> *B. severina*, 2 ♀ seen to settle *across* the sun, early in the day. Late in the afternoon many ♂ *severina* seen settled with wings three-quarters open, and tail more or less to the sun; but where much exposed to wind the wings were closed and the head turned to the wind, so as to be almost across the sun.

It is worthy of remark that throughout all these observations of heliotropism, I cannot recall a single case in which an adjustment, or subsequent movement of the butterfly after pitching, tended to throw it out of orientation. Hence it is fair to assume that if the insects had been watched longer after pitching positive results would have been observed in a larger proportion of cases.

But, be that as it may, beyond doubt it is a habit with a number of butterflies, especially Nymphalids, to settle with their backs to the sun. Whether they do this, as Professor Parker supposes, to display their charms to the greatest advantage, or whether the first impulse was

given by the light or warmth of the sun's rays, I am unable to determine, but that in the case of such species as *Pararge megæra* and *Precis clelia* the diminution of the shadow when the wings are closed helps to conceal the butterflies from their enemies I have no longer any doubt.*

Further observations will show how far the habit is general within the families in which it has been observed, and whether it prevails in other families.

The inverted attitude of Lycænids.

In the paper first referred to I drew the attention of the Society to the fact that the curious lobes at the anal angle of the hind-wings of certain Indian Lycænids, to wit species of the genera *Aphnæus, Prataqa* and *Rapala,* are everted so as to be nearly at right angles to the plane of the wing. I showed by a diagram that this eversion of the lobe helped in the suggestion of a head where the tail should be. The original sketch for the diagram was made before I had heard of the "false head theory." † The resemblance would of course be more striking if the Lycænids in question, like so many of the family, habitually rest with the head downwards.

Prof. Poulton discussed the "false head" at some length in his notes to Mr. G. A. K. Marshall's paper on "The Bionomics of South African Insects."‡ Prof. Poulton showed by a reference to Kirby and Spence that the resemblance of the tails of some Lycænids to antennæ was observed early in the 19th century. I venture to give the passage in full:—

> Dr. Arnold has made a curious observation (confirmed by Dr. Forström with respect to others of the genus) on the use of the long processes or tails that distinguish the secondary wings of *Hesperia iarbas.* These processes, he remarks, resemble antennæ, and when the butterfly is sitting it keeps them in constant motion; so that at first sight it appears to

* In the discussion which followed the reading of the paper the President (Mr. F. Merrifield) threw out the suggestion that possibly the object of negative heliotropism might be to enable the butterfly to *see* to the greatest advantage.

† Trans. Ent. Soc. Lond,, 1905, pp. 85, 86.

‡ Trans. Ent. Soc. Lond., 1902, pp. 373–375.

have a head at each extremity: which deception is much increased by a spot resembling an eye at the base of the processes. These insects, perhaps, thus perplex or alarm their assailants.*

Hesperia iarbas at first puzzled me, but it would appear to be the insect now known as *Deudorix* (*Rapala*) *iarbas*, Fab., and the very close ally of *D. melampus*, Cram., one of the insects in which I first noticed the peculiar structure of the anal lobe, about 86 years after Dr. Arnold's observation!

I remember well seeing a Lycænid at rest on a leaf at Solon, on the road to Simla, in October 1903, and was struck by its tails waving about, as I thought at the time blown by the wind.

On March 12th, 1904, the pretty white, black and orange *Talicada nyseus*, Guér., was positively swarming near Kandy. I repeatedly watched it settle with its head upwards and immediately turn about so that its head looked downwards.†

At Mortehoe, June 5th, 1905, Mr. A. L. Onslow and I searched from sundown to dusk for *Emmelesia albulata*, Schiff., in a field adjoining my house; we failed in our search, but incidentally came across a number of *Lycæna icarus*, Rott., asleep on the stems of grasses, etc. Out of fifteen specimens, twelve had the head down, three had the head up.‡

The lobed and tailed Lycænids are not too easy to observe; they are active and commonly fly about the tops of shrubs or small trees; when at rest they are not conspicuous and when disturbed dart swiftly off.

Dr. Dixey noted:—

> Aug. 20. Durban (Botanical Garden). Saw an "amphisbaenoid" *Lycæna* settled twice; the first time horizontally, the second time head downwards. On both occasions the "false head" looked much more like a head than the real one did. There was a constant slight movement of the hind-wings; and a waving of the false antennæ.

* An Introduction to Entomology, vol. ii, p. 255. First Edition, 1817.

† Trans. Ent. Soc. Lond., 1905, p. 126.

‡ When this butterfly first settles on flowers in full sunshine it expands its wings very fully, the primaries being drawn somewhat away from the secondaries.

Unfortunately this specimen eluded capture. Again Dr. Dixey noted :—

> August 16. Durban (The Bluff). Saw a Lycænid settled on the top of a leaf horizontally. The "false head" was much more conspicuous than the real head, which was almost concealed; the real antennæ were quite concealed.

This proved to be *Virachola antalus*, Hopff.; I have a note referring to the same species :—

> A Lycænid boxed off a plant close to the ground; it was sitting with the head downwards, but the "false head" was missing, having been bitten off, probably by a lizard.

Dr. Dixey was more fortunate than I with *Axiocerces harpax*, Fab., since he notes :—

> Sept. 9. Bulawayo, Rhodesia (near the Waterworks). This species was abundant at the catkin-like flowers of a shrub said by Mr. Davey to be a species of *Combretum*. When settled, it closely resembled (at a little distance) the seed vessels, of which many remained on the plant, though the latter was just coming into flower. On a near view, the false head of the Lycænid looks extremely life-like, and is moved about by the butterfly in a most deceptive manner. The species settles either horizontally or head downwards. Attention seems to be drawn to the false head by alternate partial folding and unfolding of the everted margin of the hind-wing, while the butterfly is settled. [Butterfly and seed-vessel exhibited.]

Coming now to my own observations, the "false head" was noted during life in five specimens (all females) of *Argiolaus silas*, Westw., but in none of them was the attitude at rest determined, indeed the insects usually settled high up on the trees beyond my limit of clear vision.

Sept. 10. Matopo, Rhodesia. A male of the beautiful *Stugcla bowkeri*, Trim., was twice seen to settle with its head downwards on the catkin-like racemes of the shrub *Sclerocaria caffra*. The "false head" was very obvious. It opened and shut its hind-wings while settled.

Sept. 28. East London (Buffalo River). A specimen of *Phasis chrysaor*, Trim., was seen settled head downwards.

Aug. 14. Durban (near Sydenham "Old Cemetery").

A female *Hypolycæna philippus*, Fab., exhibited a "false head," but was not seen at rest.

Sept. 15. Victoria Falls. A specimen of *Catochrysops malathana*, Bois. (=*asopus*, Hopff.), was seen in the Rain Forest settled with its head downwards.

Sept. 26. East London. Two specimens of *Tarucus telicanus*, Lang., were seen in the Queen's Park sitting horizontally. They were moving their hind-wing alternately *in the plane of the wings*, exactly as I had in the Nilgiris seen a *Lampides* do.*

Tilt to one side, or "list."

This, which I first described as "a sideways attitude," a term not without ambiguity, may be exactly defined as an attitude resulting from a rotation of the insect about its longitudinal axis, as heliotropism results from a rotation about an imaginary vertical axis at right angles to this. Heliotropism corresponds to the movement of a vessel in answer to the helm. Most vessels, independently of wind, waves, or tide, have a tendency to lean somewhat to one side or the other; this inclination is termed by sailors "a list," and, although I am aware that the analogy is not quite close, since the insect may lean at one moment to one side, at another to the other, I shall for brevity term such an inclined or tilted position *a list*.

So far as I know this list was first observed by Col. C. T. Bingham in the case of a *Melanitis* in 1878, but the observation was not published till long afterwards. The extracts from his diary of that year, brought to light by Prof. Poulton, give a most vivid description of some phases of the struggle for existence as it may be seen in a tropical forest. Col. Bingham says:—

> The *Melanitis* was there among dead leaves, its wings folded and looking, for all the world, a dead dry leaf itself. With regard to *Melanitis*, I have not seen it recorded anywhere that the species of this genus when disturbed fly a little way, drop suddenly into the undergrowth with closed wings and invariably lie a little askew and slanting, which still more increases their likeness to a dead leaf casually fallen to the ground.†

* Trans. Ent. Soc. Lond., 1905, p. 118.

† Trans. Ent. Soc. Lond., 1902, p. 363.

Mr. W. H. Edwards, in his *Butterflies of North America*, 1897, quotes Mr. William Couper's observation as to a habit of *Colias philodice*, Godt., in Anticosti :—

> When it alights on a flower, instead of being erect on its feet, it lies sideways, as if to receive the warmth of the sun.

The original passage occurs in the *Canadian Entomologist*, vol. vi, p. 92, 1874; if therefore this be truly such a list as is under discussion, Mr. Couper deserves the credit of having first observed it, but at present I am doubtful on the point.

In the summer of 1903, at Mortehoe, Dr. Dixey and I observed a like habit in *Satyrus semele*, L.; and later in that year (and in the following) I found that other British Satyrids, such as *Pararge ægeria*, L., and *Megæra*, L.; *Epinephele jurtina*, L., and *hyperanthus*, L., had a similar habit, though less marked. The butterflies when confined in a box were seen to assume the list more often in sunshine than in shade.*

In India, in the late autumn of 1893 I noted the same habit in the Satyrines *Hipparchia parisatis*, Koll., and *Aulocera swaha*, Koll.†

On the voyage out to South Africa the usual call at Madeira gave us little more than a glimpse at its butterflies. The local race of *Satyrus semele*, L., was common on the Caminho do Meio at an altitude of about 800 ft., and Dr. Dixey has this note :—

> Settled on the ground, low herbage, walls and tree-trunks. The fore-wings are depressed with a snap as in the English *semele*. Two were specially noted settling in sunshine (not strong) both turned head to sun and listed—one to port and one to starboard.

My note is :—

> A specimen seen settled face to sun, list 30° to starboard.

It was of course only to be expected that on the fifth day from leaving Southampton we should both use nautical phraseology.

South Africa contributed little to increasing our knowledge of the "list." The genus *Pseudonympha*, somewhat suggestive of *Erebia*, is characteristic of Cape Colony; at

* Entomologist's Monthly Magazine, 1905, p. 44.
† Trans. Ent. Soc. Lond., 1905, pp. 64, 135.

East London I observed several *P. cassius*, Godt., at rest, but did not see any list.

Mycalesis safitza, Hew. Though I took many odd specimens of this dingy butterfly, I never found it really common, and have but two notes of its resting attitude:—

> Berea, near the hotel, Aug. 14th, seen to settle in the shade, wings upright.

And,

> Congella, Aug. 18th. This species does not appear to orient: a slight list *away* from the sun, but sun not very bright at the time of observation.

Dr. Dixey, however, in the case of this butterfly obtained more positive results:—

> Durban (Botanic Garden), *Mycalesis safitza* has a very strong list when settled in the open; it may be to right or left in the same individual.
>
> Durban (Botanic Garden), saw *Mycalesis safitza* settled on bare ground; it had a strong list to the left. Saw it fly and settle in strong sunshine; once with its back to the sun, with list to left; once with head to sun, right list; once at right angles to sun, throwing a broad shadow.

It would therefore seem that *Mycalesis safitza* may be included among the Satyrs with a list, but this does not appear to help concealment by diminishing the shadow, as I suggested would be the case if the list were towards the sun.*

Near Darjiling, in 1903, I observed a slight list in *Mycalesis indistans*, Moore. And in Japan, in 1904, the fine Satyrid, *Blanaida goschkevitschii*, Mén., had a striking list.†

General.

That the term "Rest Attitude" is used in this paper very loosely I am well aware. A butterfly may be conceived as resting in several stages. First, it may settle to feed. *Sphinx* feeds on the wing; many a *Papilio* settles on a flower to feed, but flutters while sucking the honey, this, *e.g.*, is the habit of *P. erithonius*, Cr., *P. hector*, L., and *P. dissimilis*, L. Thus in Ceylon I found that the best way of distinguishing the last-named from the Danaids

* Trans. Ent. Soc. Lond., 1905, p. 136.

† *Loc. cit.* pp. 94, 135.

which it mimics so closely was by this fluttering. Many moths, notably *Plusia*, are intermediate between *Sphinx* and *Papilio* in this respect. The vast majority of butterflies feed with their wings still, in some cases more or less widely spread out, in others closed over the back. The Skippers of such genera as *Syricthus*, *Pamphila* and *Gegenes* settle with the hind-wings horizontal, the fore-wings nearly vertical, but other Skippers, such as *Baoris* and *Eretis*, settle with the wings fully spread out.

Again, butterflies often rest from flight on the ground, on the upper-side of leaves, or on tree-trunks. A few Skippers, such as *Celaenorrhinus*, *Caprona* and *Pterygospidea* (*Tagiades*), settle on the *under* side of leaves, with their wings spread like Geometers.

Such a state of rest is more reposeful than that first described, but in many species it is varied by occasional closing and re-opening of the wings; or in some Lycænids by curious horizontal movements of the hind-wings only.

A third stage is when they rest for a long time in one position, then the wings are usually raised over the back (even in the case of *Hesperia*, etc.) and often the fore-wings are withdrawn within the hind-wings. In some species, notably *Euchloë* and *Synchloë*, when the creature is at rest the hind-wings do not approach the stem on which it sits, but the abdomen is elevated some 30°–40° and quite concealed between the hind-wings. This attitude greatly increases the similarity of the insect to a leaf. [Exhibited.]

The actual habits of butterflies when asleep are but little known, the great majority almost certainly close their wings over their backs, but some of the larger Skippers, such as *Caprona*, etc., probably sleep with them spread out like Geometers. Certainly our common Skippers, *Pamphila sylvanus*, Esp., and *P. linea*, adopt the usual butterfly attitude, but many years ago Mr. Roland Trimen called attention to the fact that *Nisoniades tages*, L., sleeps with the wings inclined so as to form a roof, like many *Noctuæ*.* I noted in South Africa that in some Skippers the posterior third of the hind-wing is curiously plaited when at rest, thus again resembling *Noctuæ* and other moths. This may be well seen in the big *Rhopalocampta keithloa*, Wallengr., and *Pterygospidea flesus*, Fab., as well as in the little *Gegenes zetterstedti*, Wallengr. (= *hottentota*, Latr.).

* Barrett's Lepidoptera of the British Islands, vol. i, p. 309.

Intimately bound up with the attitude at rest is the question whether or no insects select resting-places of a character likely to make the most, so to say, of their cryptic colouring.

Many years ago the late Mr. Geo. Norman and myself took a lot of *Polia chi*, L., at rest close to the hydropathic establishment at Forres, and we were much puzzled by the fact that while many were taken on whitewashed walls, where they were difficult to detect, quite as many were found resting on dark tree-trunks and could be easily seen at many yards' distance.

Mr. Hamm has made some striking observations tending to an affirmative answer to this question.* In the Baghi Forest, near Simla, I was struck by the way in which the conspicuous yellow *Terias hecabe*, L., disappeared when it settled on a low shrub with oval leaves fading to a yellow tint, the rounded form of the wings aiding its concealment.† But the most convincing case that has come under my own observation was a large yellow butterfly (I had no net but think it was probably *Catopsilia catilla*, Cr.) which I saw in the garden of the University of Bombay. I saw this settle again and again, invariably in a small shrub with yellow leaves. The very conspicuous fly would vanish suddenly, and it was only after several attempts that I succeeded in getting a glimpse of it when settled, so strong was the protective resemblance.‡

In an analogous S. African case I am able to supply fuller details:—

Eronia cleodora, Hüb., is a common Natal Pierine. Few insects are more conspicuous in the net than this beautiful fly with its combination of creamy-white, jet black and deep yellow, and one might well wonder how it could possibly manage to hide itself. I watched it settle once upon the ground, and strangely enough it was not conspicuous when its wings were closed and the brilliant yellow of the under-side was fully exposed to view. Then I twice saw it settle on grass; when the wings were half open it was very conspicuous, but when they were closed it was far otherwise. Four times I saw specimens go to

* Proc. Ent. Soc. Lond., 1904, p. lxxv, and Proc. Ent. Soc. Lond., 1905, p. lxxiii, and the interesting discussion following the latter paper.

† Trans. Ent. Soc. Lond., 1905, p. 69.

‡ Trans. Ent. Soc. Lond., 1905, p. 107.

rest on the leaves of the Acanthaceous under-shrub, *Isoglossa woodii*, Clarke [= *Ecteinanthus oriyanoides*, T., and of J. Medley Wood's *Natal Plants*, vol. i, plate 22], called by the natives *u-Bomaan*, which forms the bulk of the undergrowth of the scrub on The Bluff, at Durban. It hung more or less downwards with its wings closely shut up, in which position its general shape was not unlike that of a leaf, while its colour, yellow blotched with purplish-brown, had a striking resemblance to the many yellow, eaten and blotched leaves upon the shrubs. The brilliant insect lost itself in its surroundings, although this was not a case of definite leaf mimicry as in *Kallima* or even in *Precis*. A rough-coloured sketch made at the time gives (apart from artistic shortcomings) a faithful representation of some of the leaves, though the yellow colour hardly shows by artificial light. [Sketch and butterflies exhibited.]

Dr. Dixey has a note which confirms the above :—

> The Bluff, Durban, Aug. 16. *Eronia cleodora*, ♂, observed to settle near leaves which, turned yellow and showing slits and circular holes, closely resembled its under surface.

Mr. J. Medley Wood, the Director of the Natal Botanic Gardens, kindly writing to give me the name of the plant, says that the food plants of *E. cleodora* are *Capparis zeyheri*, Turcz, and *Nicluhrria pedunculosa*, Hochst.

Perhaps the most tropical-looking butterfly that we met with in S. Africa was the large Nymphalid, *Salamis anacardii*, L.; nearly 4 inches across the wings, greenish-white, with a strong pearly lustre, it is a very beautiful creature. Its flight is very weak. Mr. A. D. Millar of Durban said that it was fond of resting in a particular tree or shrub with glaucous leaves.

Dr. Dixey has a note :—

> Sydenham, Durban, Aug. 15. Watched *Salamis anacardii*, L. It flew in a slow, flappy, undecided way from side to side of the road, settling each time for a second or two on a tree. Presently it reached a tree whose leaves were about the same size as the *anacardii* when resting with wings over its back. Here it settled, beneath a cluster of leaves, being fully exposed to view and yet well concealed. It remained quiescent until forcibly disturbed.

I have no manuscript note, but remember well that before Mr. Millar mentioned the fact of *anacardii* having a proclivity for such trees, I saw one take refuge in a shrub, or small tree, having large glaucous leaves; and I am almost sure that I beat another specimen out of the same kind of tree, but I failed to see the insect at rest.

Writing of *Colias philodice*, Godt., Mr. W. H. Edwards says: "On marigolds and brilliant single zinnias they delight to pasture, for they have a keen sense of colour. I have known one of them alight on an amethyst in a lady's ring, after hovering about its owner so persistently as to attract attention, and it rested some seconds." *

Mr. S. H. Scudder quotes the following interesting observations on the same butterfly, *Eurymus philodice*, Godt. (called in America "the sulphur").

"Dr. Minot once observed that when searching for its honied food the butterfly most frequently alighted on yellow flowers; and Dr. Packard has recorded that in a field where white asters and yellow golden rods were abundant the yellow sulphur butterfly visited the flowers of the golden rod much oftener than those of the aster, while the opposite was the case with *Pieris rapæ*." † Again, in another place, he says, "and Jenner Weir has noticed how the white butterflies settled on the variegated leaves in his garden." ‡

The preference shown by the two butterflies for golden rod and asters respectively is interesting. These genera, highly characteristic of North America, are closely allied *Compositæ*. On the other hand, *P. rapæ* was introduced into the country in 1860 or thereabouts.

Dr. Dixey has kindly placed at my disposal the notes of a number of his observations on common English butterflies which have a bearing upon the point under discussion.

> 1897, July 12, Mortehoe. *S. semele*; flight more rapid than that of *H. janira*; it is also more apt to settle. When settling, chooses if possible a bit of grey rock or bare pathway. Sits with antennæ expanded and projecting forwards, body raised somewhat on legs. At first settling, eye-spot of fore-wing generally just appears; then by a definite

* *Butterflies of North America*, vol. ii, 1897, *sub philodice* (not paged).

† *Butterflies of New England*, 1889, vol. ii, p. 1124.

‡ *Ibid.*, vol. ii, p. 1102.

sharp movement the wings are further closed, and the eye-spot is visible no longer. *H. janira* as a rule shows eye-spot while resting [*i.e.* during temporary rest in daytime].

July 12. Mortehoe. Watched *G. brassicæ*, ♂, resting on a *bramble* flower; wings closed so that the tip was the only part of fore-wing visible.

July 13. Mortehoe. Watched *V. urticæ* at rest, quite 5 m. without stirring. It raised its wings but did not completely close upper-wing behind lower, so leaving a (roughly) equivalent triangle of upper-wing showing, including the whole of the dark costal mark.

July 14. Mortehoe. *H. hyperanthus* at rest shows eye-spot of fore-wing, like *H. janira* [*i.e.* at *temporary* rest].

At 8.25 p.m. saw *H. janira* settle down to rest. Eye-spot of fore-wing quite concealed.

At 8.35 p.m. saw *P. sylvanus* resting. Wings turned up flat over back, not in characteristic "skipper" attitude.

July 15. Mortehoe. Saw *H. janira* settled (in sunshine) with eye-spot of fore-wing quite covered.

Saw *G. napi* settled with about half of discoidal cell of fore-wing showing. Afterwards saw one with only tip of fore-wing showing.

August 11. Mortehoe. *P. megæra* at rest does not shut up like *S. semele* (at least not during temporary rest in hours of flight). It usually sits with wings almost completely expanded.

Aug. 12. Mortehoe. Saw G. *rapæ*, ♂, settled, towards dusk (nearly 8.0 p.m.), on a *bramble* leaf in a hedge. Wings vertical. On left side none of fore-wing showing but bare apex. On right side a large part of fore-wing showing. On careful examination this was found to be due to the fact that the right hind-wing was split, and the fore-wing had got caught in the cleft, this preventing complete closure on that side.

Aug. 13. Mortehoe. Saw *H. tithonus* at rest; wings entirely closed up. A cloudy evening.

Aug. 23. Watched whites in Sandy Lane. When settled for rest they look very much like turned-back leaves of *bramble*, near or on which they are

fond of settling when meaning to remain settled for some time. In bright sunshine they often settle on flowers with wings partly or entirely spread, but in dull windy weather like this morning's, they are apt not to fly unless disturbed, and then to settle again very soon. I disturbed one *G. rapæ*, ♂, eight times and watched it settle again seven times. Five times it settled on *bramble*, although there was plenty of other vegetation. Of the other two times, the first was on the head of a yarrow, and the second on another low plant close to a spray of *bramble* with recurved leaves, which it closely resembled at a little distance.

Aug. 27. Saw *G. brassicæ*, ♂, settle twice on *bramble* and close up its wings.

1898. Sept. 7. Have several times lately, when coming up Sandy Lane at dusk, seen *G. rapæ* settled, apparently for the night. Generally on *bramble*, wings quite closed. They will allow themselves to be seized with fingers or forceps, but then generally wake, and fly off if let go.

Aug. 8. Observed that *L. icarus* is fairly well protected (*i.e.* concealed) on heads of bramble-blossom when wings are closed.

1898. Aug. 9. Mortehoe. Saw *H. tithonus*, ♀, settled on a bramble-leaf in sunshine, eye-spot showing. Cloud came over the sun, and *tithonus* shut up, eye-spot becoming invisible. Opened again when cloud passed.

This observation was referred to by Professor Poulton. [Trans. Ent. Soc. Lond., 1902, p. 372.] Compare the observation on *Teracolus ione*, p. 104, 105, *supra*.

1904. Highcliff, Hants. Aug. 8. Watched *G. brassicæ*, ♂, settle down for the night about 7.15 p.m. After much fluttering about the stems of tall grasses, it came to rest on a head of hawkweed in the *pappus* condition, and remained there with wings hanging downwards and closed over its back.

Recently M. J. Th. Oudemans has published an interesting memoir entitled "Etude sur la Position de Repos chez les Lepidoptères." *

* *Verhandelingen der Koninklijke Akademie van Wetenschappen.* Vol. x, No. 1. Amsterdam, 1904. (Read at Berlin, International Congress of Zoology, August 1901.)

M. Oudemans only treats of one aspect of the subject which he deals with exhaustively by numerous observations on living specimens of all the chief groups of Macrolepidoptera. His conclusions may be shortly expressed, almost in his own words, thus:—Lepidoptera have a sleeping-dress; this dress forms a harmonious whole. The different parts which contribute to form the whole dress harmonize in their colours and usually in their patterns. The parts of the insect which are concealed during rest are quite frequently strongly contrasted in colour or pattern to the exposed parts. M. Oudemans explains the facts by the influence of exposure to light.*

M. Oudemans does not allude to the points chiefly dealt with in this paper, but one of his beautiful photographs shows *Chrysophanus phlæas*, L., sitting with abdomen tilted up at an angle of about 45° to the thorax, as I have shown in the specimen of *Euchloë belemia*, Esp., exhibited. He does not however call attention to its peculiar attitude. That it must greatly increase the resemblance to a dead leaf is obvious enough.

In bringing this somewhat disconnected paper to a close I venture to make a remark which has a wide bearing on the whole question of cryptic and mimetic resemblances.

Butterflies are most numerous and varied within the tropics. In the tropics the length of daylight varies much less than in temperate zones, and is many hours shorter than in the temperate summer. At the equator the sun is above the horizon for twelve hours every day; at the tropics the sun is above the horizon from a minimum of $10\frac{1}{2}$ hours to a maximum of $13\frac{1}{2}$ hours.

But although the sun is visible for these long periods, not so the butterflies. Very few comparatively are to be seen on the move before 9 a.m., and few after 3 p.m.†

Now my point is that tropical birds, lizards, and other insectivorous animals have some six hours of full daylight in which to hunt butterflies, when the latter are more or less at rest. This is a fact not usually allowed for in the discussion of questions of protective resemblances or mimicry, but it emphasises the need for concealment.

* Compare Dr. M. Standfuss, *Die Beziehungen zwischen Färbung und Lebensgewohnheit bei den Palaertischen Grossschmetterlingen* Vierteljahrsschrift der naturforsch. Gesellschaft in Zürich. XXXIX Jahrgang, 1894. (Read November 6, 1893.)

† Mr. A. D. Millar says that in the afternoon female butterflies are relatively more commonly seen.